ferred to under the heading "Cold-wave warnings." The display called for northwest warnings on the lower Lakes, Lake Huron, and extreme eastern Lake Superior. Owing to the great rapidity with which this storm moved, the warnings on Lake Huron and western Lake Erie were lowered on the afternoon of the 30th and at night over the remainder of the lower Lakes. The maximum wind velocity reported during this storm was 72 miles an hour from the west at Buffalo, N. Y.

Fire-weather warnings.—At the request of the State forester, fire-weather warnings for northeastern Minnesota, where conditions had become serious, were begun on the 9th and were continued until the 30th.

The usual long-range forecasts for the benefit of shippers of fruit from the Pacific Northwest were begun near the close of the month to the Northwestern Fruit Exchange and the Wenatchee Valley Traffic Association, Wenatchee, Wash., and a new address added was that of the Fruit Express Co., Spokane, Wash. These forecasts have to do with expected temperature conditions in Montana and the Dakotas.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT.

Weather conditions during this month were dominated to an unusual degree by anticyclonic areas having marked characteristics.

Three large sluggish areas of high pressure advancing southeastward over the eastern Rocky Mountain slope during October 1–4, 24–26, and 28–31 were attended by much rain in the northwestern portion of the district, the rainfall at Amarillo, Abilene, and Oklahoma City exceeding the previous highest of record for October, mainly because of the heavy rains occurring in connection with these areas of high pressure. In contrast to these remarkable anticyclonic conditions, another area of high pressure, following the movement of a sluggish trough of low pressure over the central districts, dominated conditions from the 18th to the 23d, with clear and frosty weather extending much farther south in the Mississippi Valley than is usual at the season, frost in Louisiana occurring southward to the west coast at times. In the eastern portion of the district the frosty weather was prolonged until the 26th by fresh accession of high pressure from the north while rainy weather prevailed in Oklahoma and northwestern Texas.

Another important feature was the storm that developed in the western portion of the Gulf on the 15th. Special observations were obtained from coast stations, and the Washington office supplied information based on ship reports. The indications favored a northward movement, with increasing winds, and storm warnings were issued accordingly at 12:30 p. m., southeast storm warnings for the Louisiana coast and northeast warnings for the Texas coast. On the Louisiana coast the storm warnings were replaced at 10 p. m. by hurricane warnings ordered from Washington and lowered the next morning after the storm passed inland.

The storm center reached the coast at about 1 a. m. on the 16th, near longitude 91° 30′ west, slightly west of Morgan City, La., and moved rapidly northward over Louisiana, without apparent change in lowest barometer until after reaching the vicinity of Vicksburg at 7 a. m. Reports of aneroid barometers, after comparison with standard instruments, show a lowest reading of 29.25 inches at Morgan City at 1:20 a. m. to 2:45 a. m. The wind reached a velocity of 49 miles an hour at Burrwood. The velocity of 40 miles an hour was observed at Morgan City on an anemometer without continuous record, but equipped with a push-button indicator. Verifying velocity for storm warnings occurred as far west as Galveston.

On the coast south of Morgan City, with tide about 3 feet above normal, wind and waves carried two empty barges to land, leaving them stranded as the water receded, causing loss of their use in transportation of shells until they could be refloated. Other damage on the Louisiana coast, aside from the blowing down of telegraph and telephone wires, was slight. Extensive distribution was given to all warnings.

Within a long trough of low pressure extending from Canada to the Caribbean Sea, a minor disturbance developed on the 17th, following a course just slightly east of the preceding storm. Northeast storm warnings were ordered for the Louisiana Coast at 1:30 p. m.; but the disturbance had only slight effect on the Louisiana coast, the higher winds being to the eastward. The storm warnings were ordered down at 9 p. m. but with caution for small vessels proceeding eastward.

Small-craft warnings were displayed on the Louisiana coast on the 8th and 9th because of strong barometric gradient on the southern side of an area of high pressure crested over the Ohio Valley. On the 9th the warning was changed to northeast storm warning. Small-craft warnings were displayed on the west coast of Texas on the afternoon of the 13th and on the entire Texas coast on the 18th.

Frost warnings were issued on the 13th, 14th, 17th, 18th, 19th, 20th, 21st, 22d, 23d, 24th, 25th, 26th, 29th, and 31st, for portions of the district. Owing to slow clearing frost did not occur as forecast on the first two dates but generally occurred as predicted thereafter. Cold-wave warnings were issued for the northwestern portion of the district at night on the 29th and were extended the following morning over the northeastern and central portions of the district. Temperatures of freezing, or slightly higher, occurred in the northern portion of the district.

Fire-weather warnings were sent to the State forester of Texas on the 13th and 30th, particularly for increase in the velocity of northerly winds. Conditions prevailed as predicted.

Special forecasts were issued for the State Fair at Shreveport, October 18 to 28, and weather occurred as forecast.—*R. A. Dyke.*

DENVER FORECAST DISTRICT.

High pressures prevailed during most of the month in the northern and eastern portions of the Rocky Mountain region, with frequent LOWS passing across the southern portion of the district. As a result, the precipitation on the eastern slope of Colorado and New Mexico, was much above normal, with numerous heavy downpours from the 2d to the 4th and on the 12th and 13th. Heavy rains also fell in eastern Colorado on the 23d and 24th, turning to heavy snow in and near the mountains on the latter date, the heavy rains extending to eastern New Mexico on the 25th. West of the continental divide the precipitation was much lower than the average. The month was decidedly cooler than the normal in about all portions of the district.

A cold-wave warning was issued for north-central Arizona on the morning of the 17th, when the temperature at Flagstaff was 50°. A minimum temperature of 16° was registered at that station during the night of the 18th–19th.

Warnings of frost and also of freezing temperature were issued for various sections in the district on a number of dates as the weather conditions seemed to require.

As a rule, the warnings distributed were verified. A sharp rise in temperature occurred in extreme western Arizona on the morning of the 25th, however, that can not be accounted for satisfactorily.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT.

The weather in the San Francisco Forecast District during October, 1923, was largely controlled by slow moving HIGHS that entered the north coast of the United States from the Pacific Ocean. They drifted slowly eastward and apparently blocked the eastward movement of LOWS from the Aleutian Islands, which were very pronounced at sea during most of the month. One of the LOWS from the ocean moved inland on the 6th and joined forces with a LOW that apparently developed over the Southern Plateau States. The two combined caused light but general rains in this district.

The next LOW to enter the United States came by the way of British Columbia on the 16th and it caused good rains in Oregon, Washington, and Idaho, and a few showers in northern California. The strongest winds of the month attended this disturbance, when maximum velocities of 80, south, 60, southwest, and 46, south, occurred at Northhead, Tatoosh, and Seattle, respectively.

Another LOW from the Pacific Ocean entered British Columbia on the 21st. A small secondary also formed over California on the same day, and the two combined caused light but general rains in the northern half of the district and a few showers in Nevada and in extreme northern California.

On the last two days of the month a LOW appeared over the Southern Plateau States that caused light rains in the lower portion of California.

Storm warnings were issued on the 5th, 14th, 15th, and 16th. For the most part they were verified. Frost warnings were issued for portions of the north Pacific States on the 7th, 8th, 12th, 17th, 18th, 19th, and 23d. They also were verified, and as the season for vegetation at practically all places in that section closed during the month, warnings are now no longer needed in that section except near the coast.—*E. A. Beals.*

RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

Owing to the prolonged drought, all streams of the Middle and North Atlantic States were at very low stages during the greater portion of the month. Water supply for manufactories and domestic purposes almost reached the vanishing point in many localities, and many industrial plants were threatened with total suspension of operations. In some localities even drinking water had to be transported, and relief did not come until the heavy rains set in about October 23. These rains soon relieved the situation, and in the lower Connecticut River the rise assumed the proportions of a near flood. From 5 to 6 inches of rain fell over the valley below Holyoke, Mass., but without resulting flood stages in the river, owing to the extremely dry condition of the soil. Warnings of the coming of the rise were issued on October 25.

There were no floods east of the Mississippi River, but they were quite general in the western tributaries, particularly in both branches of the Canadian River and in the lower Arkansas. In the State of Oklahoma the floods were especially destructive.

Heavy rains set in during the last two days of September over the headwater areas of the Canadian River, the Texas Panhandle and extreme western Oklahoma, and extended eastward from October 1 to 3, inclusive, continuing at the same time to the westward. The heaviest rain reported was at Woodward, Okla., where 11.50 inches fell from September 29 to October 3, inclusive. Another rain period set in about October 11, with a three-day rain of 6.30 inches at Woodward. Even over the headwater districts on the eastern mountain slopes of New Mexico and in the Texas Panhandle the floods were severe, and warnings issued were well verified. The following report on the floods in the State of Oklahoma was prepared by Mr. J. P. Slaughter, meteorologist in charge of the Weather Bureau office at Oklahoma City, Okla.:

Heavy rains fell over the Texas Panhandle and western Oklahoma from October 1 to 3, and warnings were issued for Camargo, Union City, and Calvin on the Canadian River, and for Canton and Reno Junction on the 3d, and for Oklahoma City on the 5th. The water did not go as high on the Canadian River as was expected, but did reach the forecast stage at stations on the North Fork of the Canadian.

Moderate to heavy rains were general again over the two drainage basins on October 6–7, and warnings were issued for Camargo, Union City, and Calvin on the Canadian, and for Oklahoma City on North Fork of Canadian on the 6th. Again the water did not rise as high as was forecast on the Canadian, but did reach the expected stage at Oklahoma City. Neither of these floods was serious, only the very low bottom lands being inundated, and no serious losses resulted.

Excessive rains occurred over the Texas Panhandle, western, central, and northern Oklahoma, October 11 to 16, resulting in high water in the Cimarron, Arkansas, Canadian, and Red Rivers, and disastrous floods in the North Fork of the Canadian and in the Washita Rivers. On the 11th, warnings were issued for Camargo and Union City on the Canadian, and for Oklahoma City on the North Fork of the Canadian. On the 12th, warnings were issued for Canton and Reno Junction on North Fork of the Canadian; and on the 13th, for Calvin on the Canadian, and for Reno Junction and Oklahoma City on the North Fork of the Canadian, a higher stage being fixed at the last named two places. On the morning of the 15th a warning of 20 feet or higher was issued for Oklahoma City. The water was only moderately high, close to or a little above flood stage on the Canadian River, and no serious damage resulted.

The flood in the valley of the North Fork of the Canadian was the greatest and most destructive in the memory of the oldest settlers. The river rose very rapidly in northwestern Oklahoma during the 11th and 12th, reaching a stage of 9.2 feet at Woodward about 6 p. m. on the 12th. This was 0.9 foot higher than the previous high watermark, 8.3 feet, on June 10, 1923. The flood waters advanced down the valley with much greater speed than usual, continuous rains swelling the flood as it advanced. The crest stages at river stations were as follows: Woodward, 9.2 feet on the 12th; Canton, about 13 feet on the 13th; Reno Junction, about 18 feet during the night of the 14th–15th; Oklahoma City, 23.2 feet, about 7 a. m., the 16th. The previous high water stages at these stations were as follows: Woodward, 8.3 feet, June 10, 1923; Canton, 8.6 feet, June 11, 1923; Reno Junction, 14 feet, June 12, 1923; Oklahoma City, 16.3 feet, June 14, 1923.

Warnings were disseminated throughout the valley by means of long distance telephone, the State board of agriculture cooperating, by telegraph and by the daily press. Everybody in the valley had ample warning of the impending flood and that it would be the worst since the country was opened for settlement.

A systematic effort made by State, county, and city officials to determine the damage resulting from this flood fixes the total loss at not less than $15,000,000, divided as follows:

Railroad bridges, culverts, and tracks	$1,650,000
Industrial plants in Oklahoma City	175,000
Oklahoma City water works	1,500,000
Bridges and roads in nine counties	1,500,000
Destruction of crops	4,000,000
Houses and livestock, probably	500,000
Damage to land by erosion, deposit of sand, and increased flood hazard	3,000,000
Miscellaneous unlisted damage	2,675,000
Total	15,000,000

Approximately 600,000 acreas of rich farm lands were inundated during this flood, and a considerable portion of this years crops had not been gathered.

Some portions of nearly all towns and cities on the banks of the river were flooded, areas that had never before been flooded. Oklahoma City was the greatest sufferer in this respect. About 1 a. m. on the morning of October 15 a report was received from the river